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Original Article

# Effect of Different Medicinal Plants on Cholesterol (Hyperlipidemia)

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**Abstract**: Every animal cell membrane contains cholesterol, an organic chemical molecule that is a member of the fat family. Hyperlipidemia is often characterized by abnormal increases in total cholesterol, triglycerides (TGs), and low-density lipoprotein cholesterol (LDL-C) and decreases in high-density lipoprotein cholesterol. Garlic was a potent lipid-lowering drug, according to earlier reviews. Flaxseed raises good HDL cholesterol, lowers high blood cholesterol, bad LDL cholesterol, and triglyceride levels, and acts as a sweeper to clear clogged coronaries. Plant α-linolenic acid (ALA) and lignans are most abundant in flaxseed. Ficus carica fruit hydroethanol extract increased the protective advantages of high-density lipoprotein (HDL) while lowering triglycerides, cholesterol, LDL, and very low-density lipoprotein (VLDL). Alkaloids, xanthotoxols, glycosides, polyphenols, flavonoids, and numerous other chemicals are found in Ficus carica, according to analysis. Chronic administration of F. carica for three to twelve weeks has been shown to protect animal models with hyperlipidemia and hypercholesterolemia. These results imply that flavonoids, particularly apigenin 8-C-glucoside (vitexin) and quercetin-3-O-rutinoside (rutin), may be responsible for the fruit extract's hypolipidemic and hypocholesterolemic actions.

**Keywords**: *Cholesterol, Garlic, Flaxseed, Fig Tree, Anti-Hyperlipidemia Effect,*

## INTRODUCTION

Every animal cell membrane contains cholesterol, an organic chemical molecule that is a member of the fat family. Among his responsibilities is the proper stabilization of these membranes, which also affects the characteristics of animal cells. The terms "good cholesterol" (HDL) and "bad cholesterol" (LDL) are currently prevalent [1]. Hyperlipidemia is often characterized by abnormal increases in total cholesterol, triglycerides (TGs), and low-density lipoprotein cholesterol (LDL-C) and decreases in high-density lipoprotein cholesterol [2]. One of the most important risk factors is HDL levels. Higher HDL levels may be associated with a higher risk of coronary artery disease (CAD), according to recent studies [3]. Because it leads to the accumulation of hardened cholesterol deposits, or plaque, inside your blood vessels, bad cholesterol (LDL) is the most hazardous kind. This increases the risk of a heart attack or stroke by making it more difficult for your blood to pass through [4]. The main treatment for hypercholesterolemia is diet and lifestyle changes, either before or after using cholesterol-lowering medications [5].

### Garlic

The underground bulb of Allium sativum L., a member of the broad lily family, is known as garlic (Allium Sativum) [6]. In Asia, garlic (Allium Sativa L.) and turmeric (Curcuma Longa L.) have long been used to treat hyperlipidemia, infections, heart disease, diabetes, cancer, and other conditions [7]. Flavonoids and polyphenols are two powerful antioxidants found in garlic scape powder. These nutrients support lipid metabolism in addition to scavenging free radicals. These phytochemicals reduce low-density lipoprotein (LDL) and promote the production of high-density lipoprotein (HDL) (Balogun & Kang, 2022) [8].

## ANTI-HYPERLIPIDEMIA

**Effect of Garlic**

Certain animal investigations have demonstrated the anti-hyperlipidemic activity of garlic [9, 10]. However, research on the relationship between blood lipids and garlic consumption in humans has produced mixed findings. Garlic was a potent lipid-lowering drug, according to earlier reviews [11, 12]. Garlic can also limit cholesterol biosynthesis, lower fibrinogen and lipid concentrations [13, 14], decrease LDL oxidation, and boost fibrinolitic activity [15], according to certain clinical experimental research.

However, conflicting findings were found in a non-systematic review conducted in 2003 [16]. Garlic has no discernible effects on blood lipids, according to some other research [17–19]. The impact of garlic on metabolic syndrome (MetS) and coronary heart disease (CAD) is the primary subject of a number of recent meta-analyses published between 2014 and 2023. As a result, their studies revealed inconsistent TG, LDL-C, and HDL-C levels in participants who were diagnosed with hypertension, hypercholesterolemia, obesity, CVDs, or insulin resistance [20–22].

**Mechanism of Action of Garlic**

DADS and allisin are two bioactive components found in garlic that can lower cholesterol in the body [23]. Allinase molecules are transformed into allisin during garlic processing. Allisin will rapidly transform into various forms, including adjoins, diallyl sulfide (DAS), diallyl disulfide (DADS), and diallyl trisulfide (DATS). The allyl chain of DADS can be readily converted to a saturated propyl chain, which lowers NADPH and NADH levels—both of which are necessary for the synthesis of cholesterol and triglycerides. In order to create acetyl Co-A, a substrate for the synthesis of cholesterol, allisin will compete with acetate. Garlic can thereby reduce cholesterol (Riafiana F, 2017). By preventing the manufacture of cholesterol, garlic also reduces total cholesterol. Selenocysteine, SAC, aliin, DATS, and DADS are among the chemicals found in garlic that exhibit inhibitory action. Enzyme inhibition is an irreversible process. suppression of the enzyme reaction hydroxymethylglutaryl–CoA reductase and suppression of other enzyme reactions like squalene monooxygenase and lanosterol–14-demethylase are two potential methods of inhibition (Riafiana F, 2017) [24].

## FLAXSEED

Flaxseed raises good HDL cholesterol, lowers high blood cholesterol, bad LDL cholesterol, and triglyceride levels, and acts as a sweeper to clear clogged coronaries. Flaxseed consumption has also been demonstrated to raise the level of apolipoprotein A1, the main protein present in HDL cholesterol, and lower the ratio of LDL to HDL cholesterol in multiple human investigations [25]. Flaxseed may lower the risk of cardiovascular conditions like atherosclerosis or ischemic heart disease because of its high quantity of omega-3 fatty acids, lignans, protein, and soluble fiber. Improved blood lipid and lipoprotein levels have been associated with flaxseed consumption [26].

**Chemical Constituents of Flaxseed**

Plant α-linolenic acid (ALA) and lignans are most abundant in flaxseed [27,28]. Oil makes up about 38 to 45% of its bulk, of which 15 to 18% is linoleic acid and 51 to 55% is ALA [29, 30]. Oil-free flax meal weighs between 55 to 68% of flaxseed and has about 16.4 mg/g of secoisolariciresinoldiglucoside (SDG) [31]. The seed coat contains the majority of SDG [32]. SDG contains 0.6–6 g of flaxseeds per 100 g [33]. By weight, the flax lignan complex extracted from flaxseeds is made up of 34–38% SDG, 15–21% cinnamic acid glucoside, and 9.6–11% hydroxymethylglutaric acid [34]. Flaxseed contains proteins (10.5–31.0% by weight) [29] and fiber (25–28% by weight), of which 25% is in the soluble form [35]. CDC-flaxseed is a different type of flaxseed that has just 2 to 3% ALA by mass, but it has an oil and SDG content comparable to regular flaxseed. This flaxseed type affects serum lipids differently [31].

**Antihyperlipidemic Activity of Flax**

Serum levels of TC, HDL-C, and TG did not significantly change when firefighters were given flax oil at doses of 1.2, 2.4, and 3.6 g/d for 12 weeks [36]. TC levels were considerably lowered ($4.95 \pm 0.99$ vs. $5.43 \pm 0.00$ mmol/dL) when flax oil with 3-g ALA was given to 56 people without coronary artery disease for 26 weeks [37]. However, the serum levels of HDL-C, LDL-C, and TG did not significantly change, according to these researchers. LDL particle size was unaffected by ALA. The concentrations of big, less atherogenic LDL-1 and LDL-2 subfractions were unaffected. According to Kaul et al. [38], giving healthy patients oral flax oil (1 g/d) for three months did not considerably change their serum levels of TC, HDL-C, LDL-C, and TG.

Serum TG, TC, HDL-C, LDL-C, Apo-A1, and Apo-B levels in healthy persons were not significantly changed by a flax oil diet that derived 28.8% of its energy from fat [39]. ALA (9.2 g/d for 6 weeks) had no effect on plasma LDL-C, TG, or VLDL-C in 33 men with moderately hypercholesterolemia and normotension, according to Kestin et al. [40].

Serum levels of TC, TG, HDL-C, and LDL-C did not change when 40 dyslipidemic patients (aged 38–71 years) consumed flax oil containing 8.1-g ALA/d for 12 weeks [41]. When given to healthy people for 12 weeks, flaxseed oil (15 g/d) containing 8 g ALA decreased serum levels of HDL-C (42.7 ± 10.4 vs. 42.0 ± 10.2 mg/dL, $p < 0.005$), but had no effect on TC, TG, and LDL-C [42]. According to Singer et al. [43], giving 14 patients with mild essential hypertension 60 mL/d of flaxseed oil for two weeks dramatically reduced their serum levels of TC, LDL-C, TG, and LDL-C/HDL-C ratios. Serum levels of TG and apolipoprotein-B were considerably reduced in healthy participants who received flaxseed oil (30 mL/d for 4 weeks), at 1.23 ± 0.64 vs. 1.03 ± 0.44 mmol/L and 1.06 ± 0.24 vs. 1.00 ± 0.25 g/L, respectively [44]. Additionally, it considerably reduced the TC/HDL-C ratio (4.15 ± 1.44 vs. 3.85 ± 1.19). Mirfatahi et al. [45] shown that flaxseed oil (6 g/d for 8 weeks) effectively lowered serum TG levels by 23% in a double-blind controlled experiment involving 34 hemodialysis patients. The serum levels of TC, LDL-C, HDL-C, and lipoprotein (A) did not significantly change.

Akrami et al [46] reported that flax oil (25 mL/d) given to patients with metabolic syndrome for 7 weeks reduced the serum levels of TC, TG, LDL-C, and HDL-C by 18.23 ± 25.45 mg/L ($p < 0.001$), 52.46 ± 74.32 mg/dL ($p = 0.001$), 7.19 ± 17.47 mg ($p = 0.46$) and −1.38 ± 3.34 mg/dL ($p = 0.45$), respectively. Consumption of 10mL of flaxseed oil (6-g ALA/day) for 14 days in young women did not significantly alter the concentration of TC (4.44 ± 0.73 vs. 4.49 ± 0.88 mmol/L), LDL-C (2.55 ± 0.68 vs. 2.63 ± 0.73 mmol/L), HDL-C (1.50 ± 0.30 vs. 1.50 ± 0.32 mmol/L), and TG (1.03 ± 0.36 vs. 0.96 ± 0.35 mmol/L) compared with baseline [47]. Another study examined the effects of daily use of 10-g flax oil containing 5.49-g ALA and 10-g corn oil containing 0.09-g ALA for 12 weeks in 15 patients. Compared to maize oil, flax oil considerably lowered CETP levels. Additionally, compared to maize oil, flax oil significantly reduced serum levels of TC, LDL-C, HDL-C, and non-HDL-C, Apo-A1, and Apo-B. Neither flax oil nor corn oil had an impact on the TG levels. According to the research, flax oil undoubtedly lowers TC, LDL-C, HDL-C, non-HDL-C, Apo-A, and Apo-B levels [48].

## THE FIG TREE

One of the oldest fruit-bearing trees, the fig tree (F. Carica L.) is prized for both its culinary and therapeutic qualities [49]. With more than 800 species of trees, shrubs, hemiepiphytes, climbers, and creepers found across the tropics and subtropics, Ficus is one of the largest angiosperm genera [50]. One of the earliest trees in the world to be grown, F. carica, also called fig, is a deciduous member of the Moraceae family that can be consumed both fresh and dry [51–53]. Ficus carica is the usual botanical name for figs, which are members of the plant family. Figs are thought to have hypolipidemic properties [54].

Traditionally, Ficus carica, also known as figs (Anjeer), has been used to cure a number of conditions, including cancer, diabetes mellitus, hyperlipidemia, stomach issues, and inflammation [55]. Ficus carica fruit hydroethanol extract increased the protective advantages of high-density lipoprotein (HDL) while lowering triglycerides, cholesterol, LDL, and very low-density lipoprotein (VLDL) [56]. Alkaloids, xanthotoxols, glycosides, polyphenols, flavonoids, and numerous other chemicals are found in Ficus carica, according to analysis. Ficus carica fruit and leaves have been proven to have hypolipidemic effects in addition to other medicinal purposes such as hypoglycemia, hepatoprotective, antispasmodic, antipyretic, anti-HSV, antioxidant, and antibacterial properties. Ficus carica has a hypolipidemic effect on serum and hepatic cholesterol [57].

**Anti-Hyperlipidemic Properties of Figs**

In 1999, Pérez et al. conducted a study on the potential benefits of F. carica as a lipid-lowering agent. The study used a rat model of hypertriglyceridemia, giving the animal unrestricted access to 20% long-chain triglyceride (LCT) emulsion for two hours following a 22-hour fast. Plasma triglyceride (TG) levels were significantly lower at 60 and 90 minutes after acute intraperitoneal dose of F. carica leaf decoction (5000 mg/kg) [58]. In a different study, total cholesterol (TC) levels in the serum and liver of rats with hyperlipidemia were reduced by acute administration of F. carica leaf aqueous extract (the aqueous fraction that remained in the petroleum ether-treated total extract) at different dosages of 10, 50, and 250g/kg. The same study's phytochemical screening revealed that the F. carica leaf extract included a high concentration of tannins, a moderate level of flavonoids, and a modest amount of alkaloids, all of which may have contributed to the acute in vivo anti-hyperlipidemic actions [59]. Serum TG, TC, low-density lipoprotein (LDL-C), very low-density lipoprotein (VLDL-C), and high-density lipoprotein (HDL-C) significantly decreased when F. carica leaf and twig extracts were administered at doses of 150 and 300 mg/kg in mice with hyperlipidemia induced by a single intravenous injection of Triton WR 1339 (300 mg/kg body weight). While the phenolic and flavonoid contents of F. carica leaves and twigs ranged from 12.84 to 19.78 mg gallic acid equivalents (GAE) and 5.02 to 9.72 mg EQ/g dry matter, respectively, the investigation found that the LD50 value of twig and leaf extracts was larger than 5000 mg/kg [60].

Chronic administration of F. carica for three to twelve weeks has been shown to protect animal models with hyperlipidemia and hypercholesterolemia [61–64]. TG, interleukin-6 (IL-6), atherogenic index (AI), coronary risk index (CRI), TC, and LDL-C were significantly reduced in high-fat diet (HFD) mice supplemented with F. carica leaf extracts at doses of 50 and

100 mg/kg for 6 weeks [62] and 400 mg/kg for 3 weeks [64]. Similarly, after HFD-induced rats were given 400 mg/kg of F. carica fruit extracts for three weeks, there were notable decreases in the plasma levels of TC, TG, LDL-C, and AI [64]. and 8 weeks [61].

These results imply that flavonoids, particularly apigenin 8-C-glucoside (vitexin) and quercetin-3-O-rutinoside (rutin), may be responsible for the fruit extract's hypolipidemic and hypocholesterolemic actions [61]. Similar results were recently shown by Perveen et al., who showed that supplementing HFD-induced rats with F. carica pulp extracts (1250 mg/kg) for 12 weeks significantly reduced the plasma levels of TC, TG, LDL-C, HDL/LDL ratio, and AI while increasing HDL-C [63].

## CONCLUSION

By addressing the underlying reasons of imbalance in the body's doshas—Vata, Pitta, and Kapha—herbal treatment provides a comprehensive and long-lasting method of lowering cholesterol and enhancing cardiovascular health. Herbs can lower cholesterol whether taken orally or as whole plant supplements. Recent medications, a diet, home treatments, and regular exercise can all be used to manage hyperlipidemia. Maintaining a healthy diet and being physically active can lower the risk of hyperlipidemia. Medicinal plants can also help treat the condition, but doing so necessitates a thorough understanding of both the illness and the plant. Concerns about the adverse effects of chemical drugs and a desire for low-risk, natural methods have led to an increase in interest in traditional medicine and medicinal plants as possible alternatives for treating hyperlipidemia in recent years.

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